

WHAT IS CLAIMED IS:

1. A method for machining a glass substrate in which a concave portion is formed in a surface of said glass substrate by laser beam irradiation, comprising the step of:

5 irradiating said surface of said glass substrate to be machined with a laser beam from above said glass substrate in a state that said laser beam is condensed into a portion outside said glass substrate.

10 2. The method according to claim 1, wherein, in said state, said laser beam is condensed in said portion outside and above said glass substrate.

3. The method according to claim 1 or 2, further comprising the step of:

15 changing a distance between a beam-condensing point of said laser beam and said surface of said glass substrate.

4. The method according to any one of claims 1 to 3, further comprising the step of:

20 moving said beam-condensing point of said laser beam relatively in a direction parallel to said surface of said glass substrate.

5. The method according to any one of claims 1 to 4, wherein said laser beam is pulsed light having a pulse width not larger than 10 picoseconds.

25 6. AV-shaped groove formed in a surface of a glass substrate by a method for machining said glass substrate as defined in

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any one of Claims 1 through 4, wherein an angle of from 30 degrees to 120 degrees is formed between opposite side surfaces of said V-shaped groove.

7. A method of forming at least one V-shaped groove on a surface of a glass substrate, the method comprising the steps of:

adjusting laser beam so that each pulse of said laser beam is applied onto the surface of the glass substrate in a defocused state;

10 partially ablating the surface of the glass substrate with the thus adjusted laser beam in said defocused state to form said v-shaped groove;

8. The method of claim 7, wherein said step of partially ablating includes scanning the thus adjusted laser beam along the surface of said glass substrate.

9. The method of claim 7, wherein a focal point of each pulse of said laser beam is located at a position outside the glass substrate and upstream relative to the glass substrate.

10. The method of claim 7, wherein a focal point of each pulse of said laser beam is located at a position outside the glass substrate and downstream relative to the glass substrate.

11. A glass substrate having at least one v-shaped groove on a surface thereof, said glass substrate obtained by a method comprising the step of adjusting laser beam so that each pulse of said laser beam is applied onto the surface of the glass substrate

in a defocused state, and partially ablating the surface of the glass substrate with the thus adjusted laser beam in said defocused state.